MG3670A / MG3670B

Digital Modulation Signal Generator

Service Manual

First Edition

Measuring Instruments Division
Measurement Group

ANRITSU CORPORATION

FEB.
1995

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MG3670A / MG3670B Digital Modulation Signal Generator

Service Manual

November 1994 (First Edition)

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Printed in Japan

WARNING

- *The protective earth terminal of this instrument must be connected to ground. The three-core power cord supplied with the instrument can be plugged into a grounded two pole AC outlet. If no grounded two pole AC outlet is available, the ground pin of the power cord or the earth terminal on the rear panel must be connected to ground before supplying the power to the instrument. Failure to do so could cause dangerous or possibly fatal electric shocks.*
- *Replacing fuses with the power cord still plugged into an AC outlet could also cause electric shocks.*
- ***Supplemental explanation about WARNING on the rear panel***

WARNING ⚠
NO OPERATOR SERVICE-ABLE PARTS INSIDE.
REFER SERVICING TO QUALIFIED PERSONNEL.

A supplemental explanation about the WARNING labelled on the rear panel is given in the following:

Disassembly, adjustment, maintenance, or other access inside this instrument by unqualified personnel should be avoided. Maintenance of this instrument should be performed only by Anritsu trained service personnel who are familiar with the risks involved of fire and electric shock. Potentially lethal voltages existing inside this instrument, if contacted accidentally, may result in personal injury or death, or in the possibility of damage to precision components.

■ SAFETY CONSIDERATIONS:

Anritsu uses the following labels to identify safety precautions which should be followed to prevent personal injury or product damage. Please familiarize yourself with them before operating this product.

Labels used in this manual:

WARNING Indicates that the procedure could result in personal injury if not correctly performed. Do not proceed before you fully understand the explanation given with this symbol and meet the required conditions.

CAUTION Indicates that the operating procedure could result in damage to the product if not correctly performed. Do not proceed before you fully understand the explanation given with this symbol and meet the required conditions.

Labels or symbols used on / in the product:

高圧危険
DANGER
HIGH VOLTAGE : This warning symbol (red color) indicates that the operator should not touch the labeled location. Servicing should only be performed by qualified personnel.

: This symbol indicates hazardous voltages. Be careful (not used in this instrument).

: This international caution symbol indicates that the operator should refer to the operation manual before beginning a procedure.

: This symbol indicates an earth (ground) terminal. The product should be grounded via the earth terminal if a three prong power cord is not used.

■ Disposal:

The MG3670A / B contains semiconductors containing arsenic compounds and fluorinated graphite lithium batteries. When disposing of the MG3670A / B, be sure to handle it according to the regional regulations.

CERTIFICATION

ANRITSU CORPORATION certifies that this instrument has been thoroughly tested and inspected, and found to meet published specifications prior to shipping.
Anritsu further certifies that its calibration measurements are based on the Japanese Electrotechnical Laboratory and Radio Research Laboratory standards.

WARRANTY

All parts of this product are warranted by Anritsu Corporation of Japan against defects in material or workmanship for a period of one year from the date of delivery.
In the event of a defect occurring during the warranty period, Anritsu Corporation will repair or replace this product within a reasonable period of time after notification, free-of-charge, provided that: it is returned to Anritsu; has not been misused; has not been damaged by an act of God; and that the user has followed the instructions in the operation manual.

Any unauthorized modification, repair, or attempt to repair, will render this warranty void.

This warranty is effective only for the original purchaser of this product and is not transferable if it is resold.

ALL OTHER EXPRESSED WARRANTIES ARE DISCLAIMED AND ALL IMPLIED WARRANTIES FOR THIS PRODUCT, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO A PERIOD OF ONE YEAR FROM THE DATE OF DELIVERY. IN NO EVENT SHALL ANRITSU CORPORATION BE LIABLE TO THE CUSTOMER FOR ANY DAMAGES, INCLUDING LOST PROFITS, OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES, ARISING OUT OF THE USE OR INABILITY TO USE THIS PRODUCT.

All requests for repair or replacement under this warranty must be made as soon as possible after the defect has been noticed and must be directed to Anritsu Corporation or its representative in your area.

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'HP' is a registered trademark of the Hewlett-Packard Company.
'NEC' is a registered trademark of the NEC Corporation.

MEMORY BACK-UP BATTERY REPLACEMENT

The power for memory back-up is supplied by a Poly-carbomonofluoride Lithium Battery. This battery should only be replaced by a battery of the same type; since replacement can only be made by Anritsu, contact the nearest Anritsu representative when replacement is required.

STORAGE MEDIUM

This equipment stores data and programs using backed - up memories . Data and programs may be lost due to improper use or failure.

ANRITSU CANNOT COMPENSATE FOR ANY MEMORY LOSS.

Please pay careful attention to the following points.

(Backed-up memory)

- Isolate the memory from static electricity.

Note: *The battery life is about 7 years. Early battery replacement is recommended.*

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TABLE OF CONTENTS

		Page
1	GENERAL	
2	CIRCUIT DESCRIPTION	
	2.1 Overall	2-1
	2.2 RF Section	2-1
	2.2.1 A101 RF MOTHER 1	2-1
	2.2.2 A102 RF MOTHER 2	2-1
	2.2.3 A103 FILTER BOARD 1	2-1
	2.2.4 A104 FILTER BOARD 2	2-1
	2.2.5 A106 LOCAL and A105 RF CONT	2-1
	2.2.6 A107 MODULATOR	2-11
	(1) A1071 DC FILTER CONTROL 1	2-11
	(2) A1072 DC FILTER CONTROL 2	2-11
	(3) A1073 MODULATOR BOARD 1	2-11
	(4) A1074 MODULATOR BOARD 2	2-11
	(5) A1075 1.5GHz GENERATOR	2-12
	2.2.7 A108 CONVERTER	2-16
	(1) A1081 CONVERTER FILTER	2-16
	(2) A10821 4.2GHz PLL	2-16
	(3) A10822 4.2GHz OSC	2-16
	(4) A1083 2ND BEAT UP	2-16
	(5) A1084 DOWN CONVERTER	2-16
	2.2.8 A109 AMP	2-20
	(1) A1091 RF AMP	2-20
	(2) A1092 CONNECT BOARD 1	2-20
	(3) A1093 R.P.P	2-20
	(4) A1094 RF DRIVER 1, A1095 RF DRIVER 2	2-20
	(5) A1096 CONNECT BOARD 2	2-20
	2.2.9 A110 10/100MHz REF	2-25
	2.2.10 A111 1/10,13 DIVIDER	2-25
	2.2.11 Troubleshooting RF section	2-27
	2.3 A204 CPU BOARD	2-31
	2.4 A205 ASP1	2-32
	2.5 A206 ASP2	2-32
	2.6 A3 MOTHER BOARD	2-32
	2.7 A4 PANEL PART	2-32
	2.8 A701 $\pi/4$ DQPSK	2-32
	2.9 A702 GMSK	2-32

2.10 A9 UNIT3 BURST 2-33
2.10.1 Generating burst pattern 2-33
(1) Configuration of burst pattern 2-33
(2) Generating CRC 2-33
(3) Adding scramble 2-33
(4) Generating PN-pattern information 2-33
(5) Synchronizing burst pattern to external trigger 2-34
2.10.2 Controlling I/Q amplitude 2-34
2.11 A703 GFSK 2-34

SECTION 1
GENERAL

This is the service manual of the MG3670A/MG3670B Digital Modulation Signal Generator for smooth maintenance and service work.
Refer to the separate operation manual for handling the instruments.
Our basic policy to the repair is return to the factory system, i.e. the defective instrument should be returned to Anritsu for repair.

However, it may be time consuming and some kinds of repairs can be easily done in the field.
Therefore, Anritsu allows only those whom Anritsu has authorized to open the instrument and repair it.
As clearly stated in the WARRANTY statement, any unauthorized modification, repair, or attempt to repair will render the warranty void.

This service manual is composed of SECTION 1 and SECTION 2.
The SECTION 2 describes the operation of the circuits and the role of each unit.

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SECTION 2
CIRCUIT DESCRIPTION

The SECTION 2 describes the operation of the circuits and the role of each units.

2.1 Overall

Fig. 2-1 shows overall block diagram.

2.2 RF Section

2.2.1 A101 RF MOTHER 1

Sends dc power and local-frequency control data from A3 MOTHER BOARD to A1051 RF CONT 1.

2.2.2 A102 RF MOTHER 2

Sends dc power and local-frequency control data from A1052 RF CONT 2 to A106 LOCAL 2.

2.2.3 A103 FILTER BOARD 1

Contains dc power-voltage regulators to dc-power filters, EL panel, and fans of the A105 RF CONT; and connects the power-supply unit to A3 MOTHER BOARD.

2.2.4 A104 FILTER BOARD 2

Contains dc power-supply filters of A107 MODULATOR and A108 CONVERTER.

2.2.5 A106 LOCAL and A105 RF CONT

Generates the local signal to convert the 5.4GHz modulated signal to the output frequency signal.

- Input
  - 1)Reference signal
    - Frequency 10 MHz
    - Level +10 dBm
  - 2)Reference signal
    - Frequency 100 MHz
    - Level ≧+7 dBm

- Output
  - 1)Local signal
    - Frequency 5400 to 7650(7500*) MHz/1Hz step
    - Level -9.5 dBm
  - 2)Reference signal
    - Frequency 100 MHz
    - Level +7 dBm
  - 3)100MHz VCXO control voltage -6 to +10V

---

*: for MG3670A

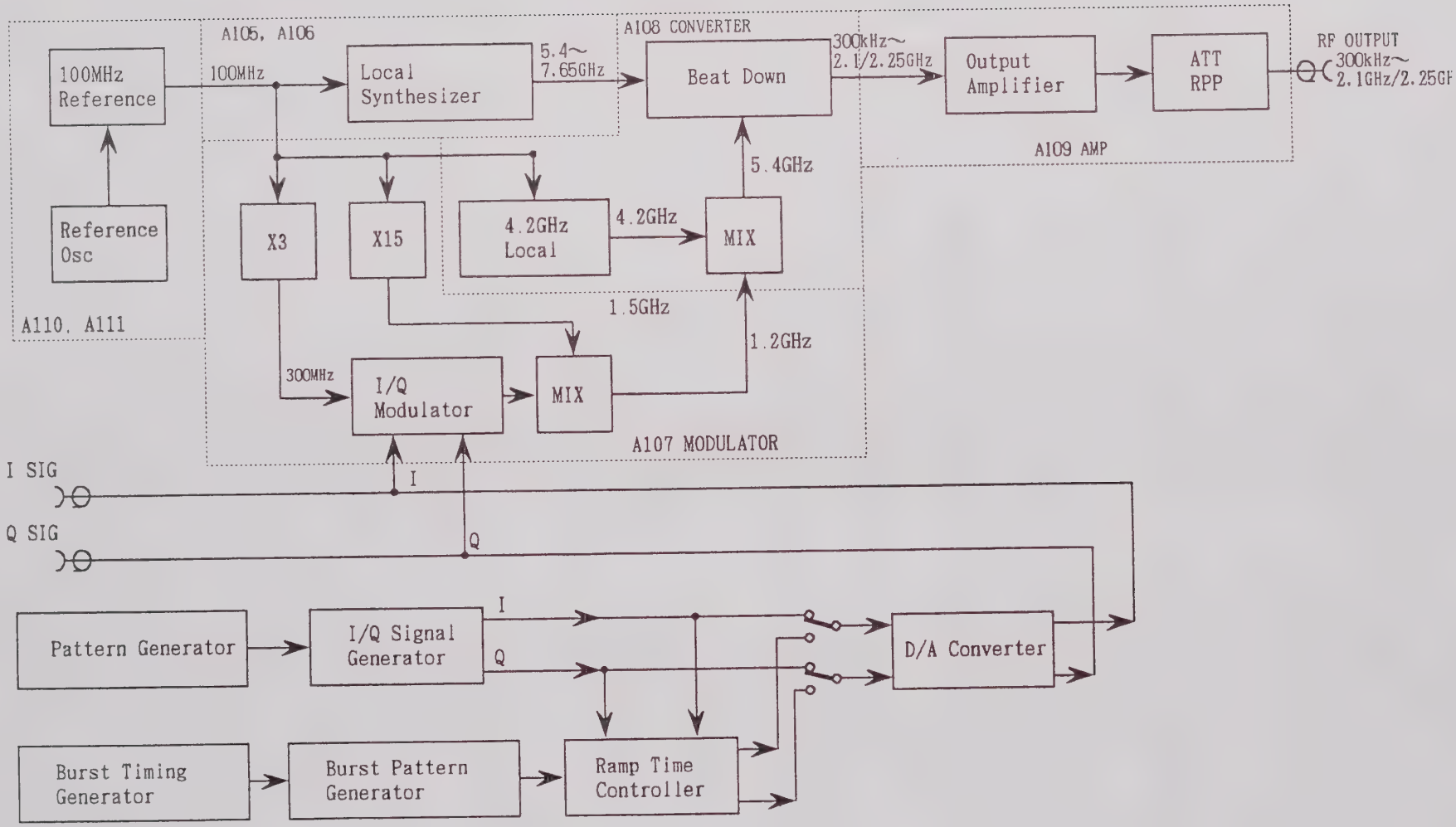

Fig. 2-1 MG3670A/B Block Diagram

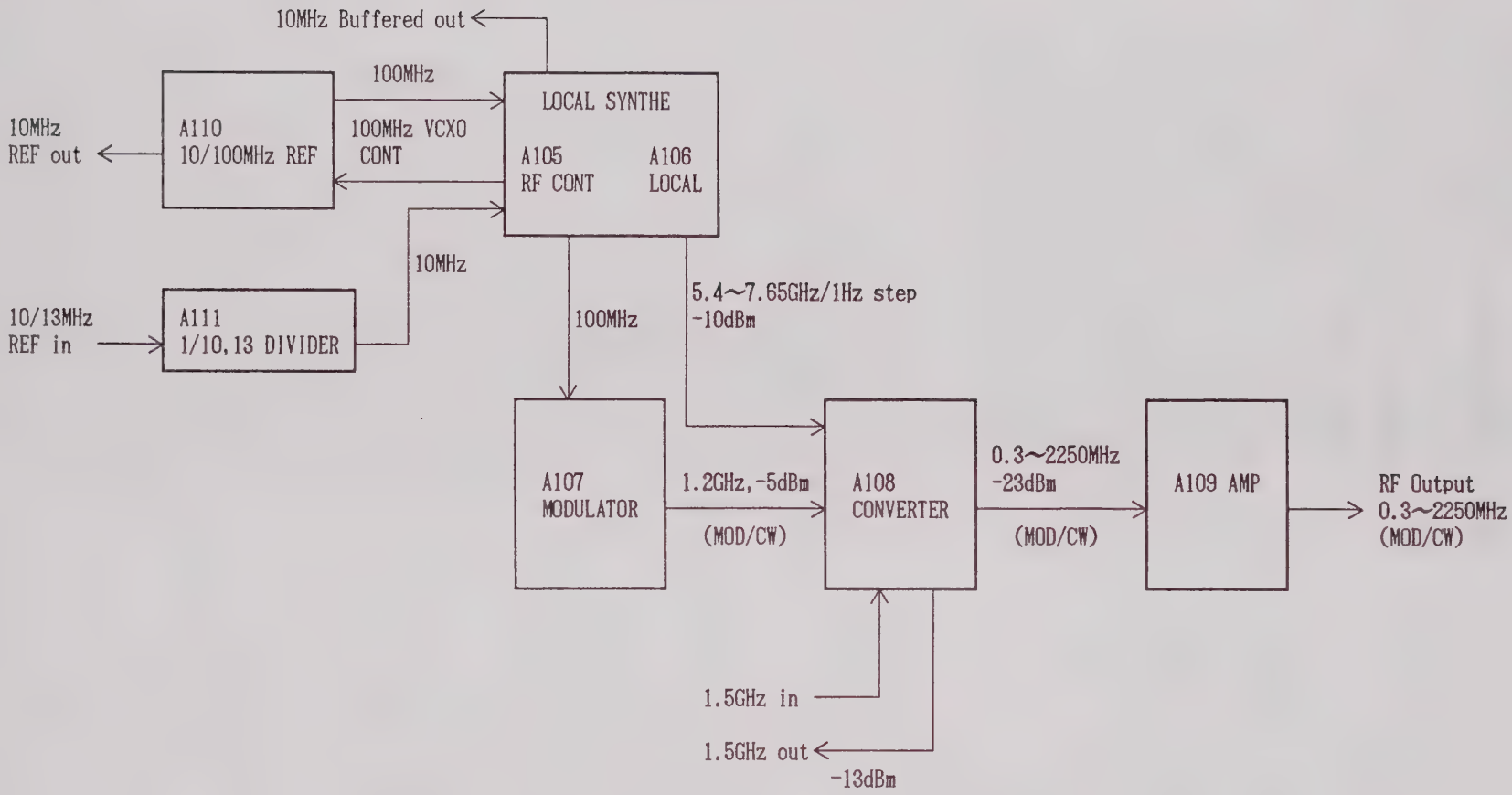

Fig. 2-2 RF Section Block Diagram

[Calculating local frequency]

The local signal is output from A112 YTO, and the frequency fYTO is derived from the following equation.

fYTO = (Setting frequency) + 5400 [MHz]

A106 LOCAL has 3 frequency synthesizers of 1MHz step/10kHz step/1Hz step, and the block diagram is shown in Figs. 2-3 to 2-5.

When the fYTO is as shown below,

fYTO = X4 X3X2X1.Y2Y1Z4 Z3Z2Z1 [MHz]

each synthesizer output frequency is calculated as described below.

```
Type(1): When X2X1 = 00～24,  M = X4X3-1, N = X2X1+13
Type(2): When X2X1 = 25～49,  M = X4X3-1, N = X2X1-12
Type(3): When X2X1 = 50～74,  M = X4X3+2, N = 87-X2X1
Type(4): When X2X1 = 75～99,  M = X4X3+2, N = 112-X2X1
```

FK=Y2Y1/10
FH=Z4Z3Z2Z1/1000

fN=100+N [MHz]

```
For Type(1)/Type(2)
  fSAMPLE = 100 + fN/M   [MHz]
Type(3),Type(4)
  fSAMPLE = 100 - fN/M   [MHz]
```

```
For Type(1)/Type(3)
  f10kHz = 127.7 - FK   [MHz]
  f1Hz   = 230   - FH   [MHz]

For Type(2)/Type(4)
  f10kHz = 117.8 + FK   [MHz]
  f1Hz   = 220   + FH   [MHz]
```

fREF = f10kHz/10 + f1Hz/1000

```
Type(1): fYTO = 100*M + fN - fREF
Type(2): fYTO = 100*M + fN + fREF
Type(3): fYTO = 100*M - fN - fREF
Type(4): fYTO = 100*M - fN + fREF
```

Example 1 : Setting frequency is 1510.4 MHz

fYTO = 1510.4 + 5400 = 6910.4 [MHz]
↑ Type(1)

M = 69 - 1 = 68
N = 10 + 13 = 23
FK = 40/10 = 4
FH = 0000/1000 = 0

fN = 100 + N = 123 [MHz]
fSAMPLE = 100 + fN/M = 101.8088 [MHz]

f10kHz = 127.7 - FK = 123.7 [MHz]
f1Hz = 230 - FH = 230 [MHz]
fREF = f10kHz/10 + f1Hz/1000 = 12.6 [MHz]

Example 2 : Setting frequency is 2095.7 MHz

fYTO = 2095.7 + 5400 = 7495.7 [MHz]
↑ Type(4)
M = 74 + 2 = 76
N = 112 - 95 = 17
FK = 70/10 = 7
FH = 0000/1000 = 0

fN = 100 + N = 117 [MHz]
fSAMPLE = 100 - fN/M = 98.4605 [MHz]

f10kHz = 117.8 + FK = 124.8 [MHz]
f1Hz = 220 + FH = 220 [MHz]
fREF = f10kHz/10 + f1Hz/1000 = 12.7 [MHz]

	Freq. range (MHz)	Level	check point
fSAMPLE	97.554～98.513 101.507～102.585	≧+10dBm	A1061-J15
f10kHz	117.8～127.7	-12dBm(Typ)	A1062-J5
f1Hz	220～230	-8dBm(Typ)	A1062-J4
fREF	12～13	0dBm	A1062-W6
fN	113～137	-12dBm(Typ)	A1061-J10

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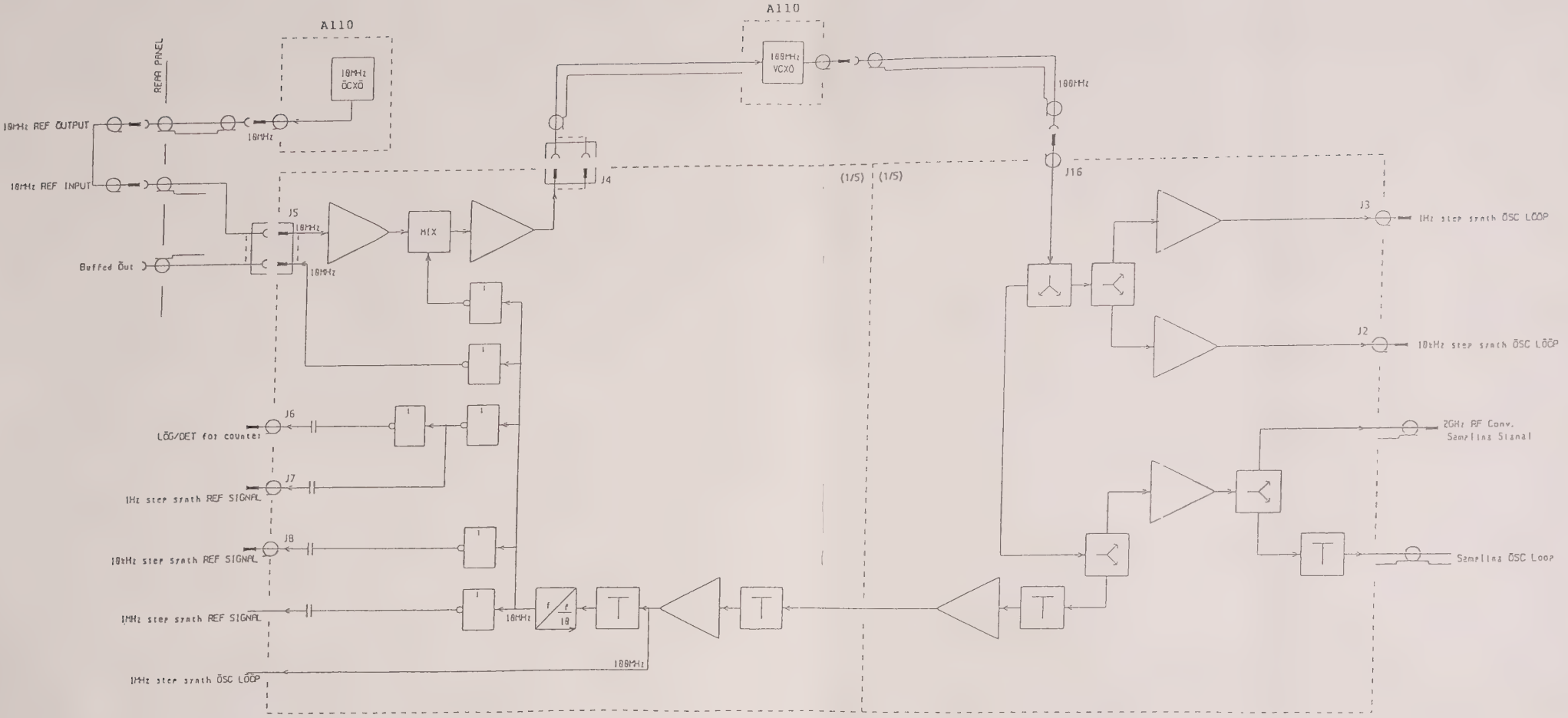


Fig. 2-4 A1061 LOCAL 1 Block Diagram (2/2)

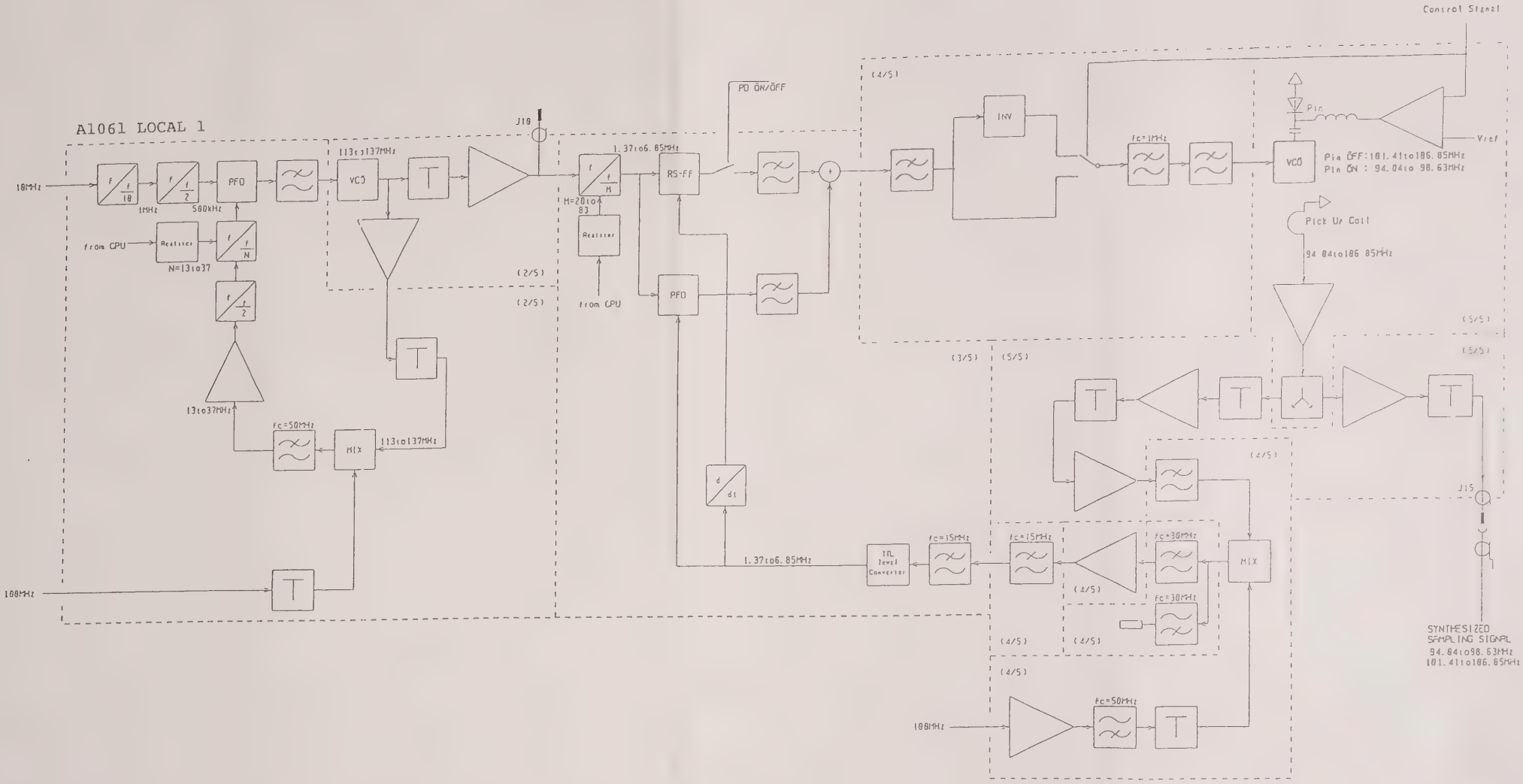
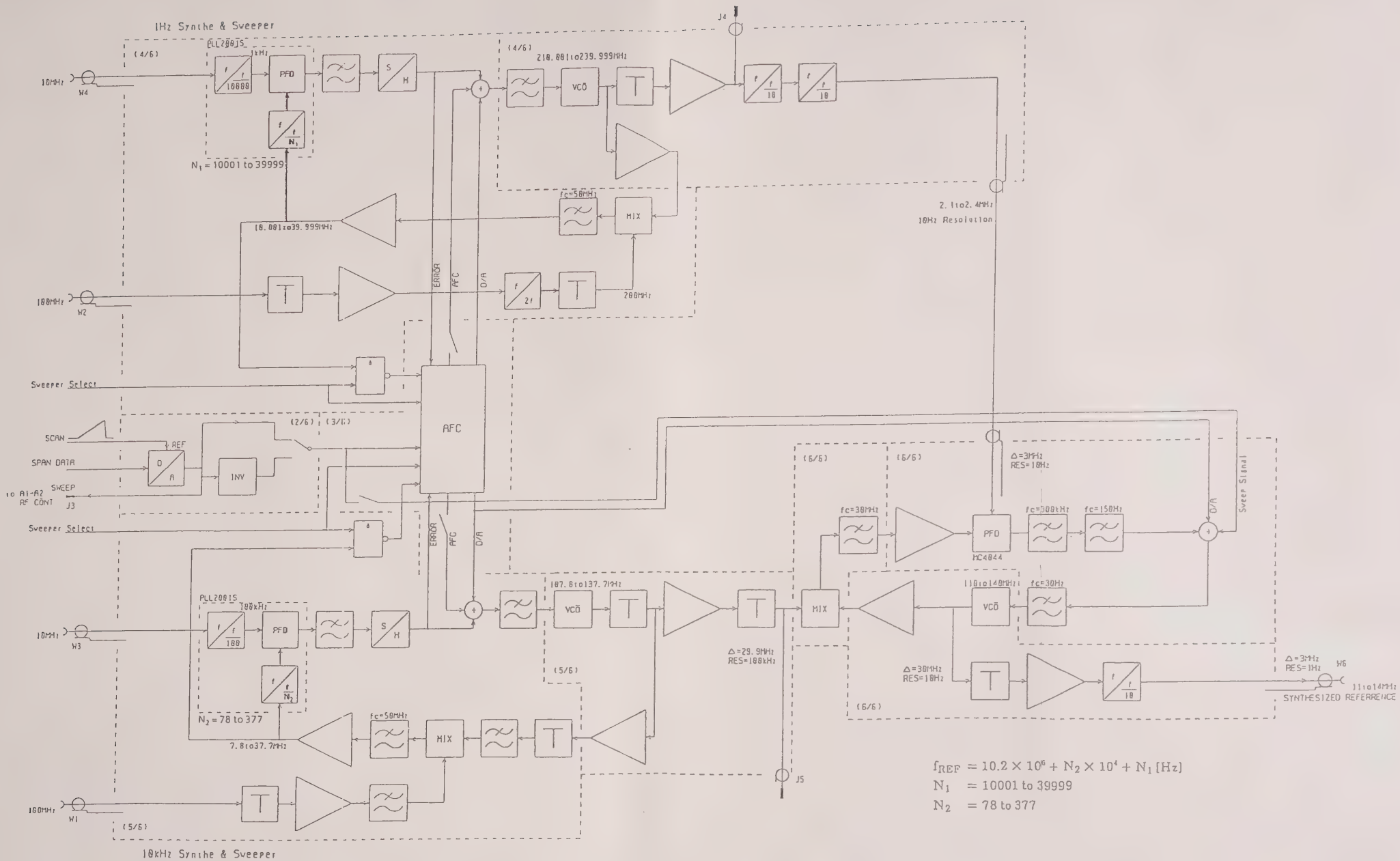


Fig. 2-3 A1061 LOCAL 1 Block Diagram (1/2)



$$f_{REF} = 10.2 \times 10^6 + N_2 \times 10^4 + N_1 \text{ [Hz]}$$
$$N_1 = 10001 \text{ to } 39999$$
$$N_2 = 78 \text{ to } 377$$

Fig. 2-5 A1062 LOCAL 2 Block Diagram

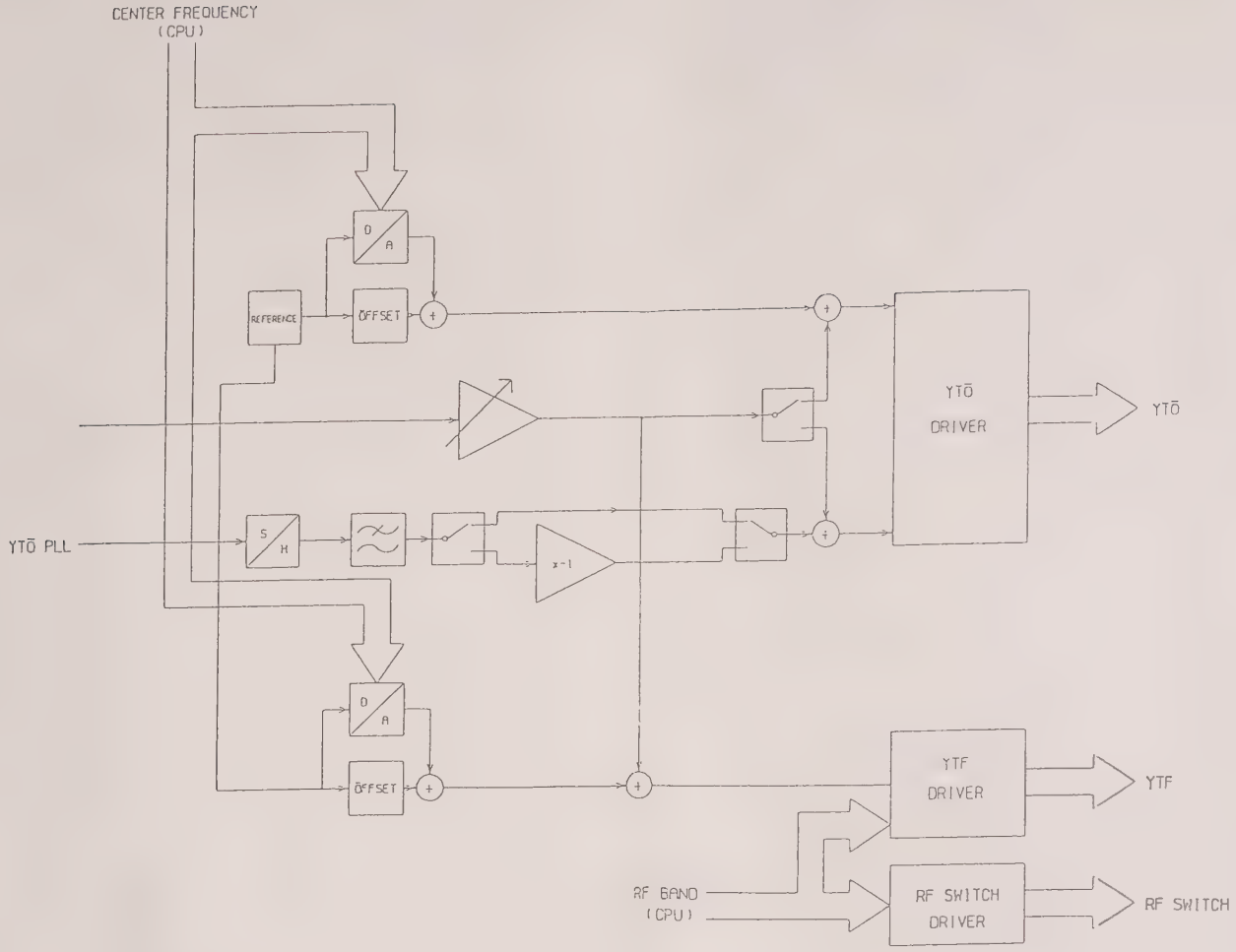


Fig. 2-6 A105 RF CONT Block Diagram

2.2.6 A107 MODULATOR

Receives 100MHz reference signal and I/Q signals, and generates 1.2GHz vector modulated signal.

(1) A1071 DC FILTER CONTROL 1

- Supplies power to each unit and heaters of A107 MODULATOR.
- Reject power-supply noise.
- Sends dc power and signals to A1072 DC FILTER CONTROL 2.

(2) A1072 DC FILTER CONTROL 2

- Supplies dc power to A1074 and A1075.
- Using the control signal from A1071, generates A1074 Z1 and Z2 (PIN-diode module) control signal with a 12-bit D/A converter.
- Switches the time constant of A1074 Z1 and Z2 control signal.

(3) A1073 MODULATOR BOARD 1

Generates 300MHz vector modulated signal and 100MHz reference signal using 100MHz reference signal.

- Input

1) Reference signal

Frequency	100 MHz
Level	+7 dBm

2) I/Q signal

Frequency	DC～2.4 GHz
Level	+0 dBm

·Output

1) Modulated signal

Frequency	300 MHz
Level	-5 dBm

2) Reference signal

Frequency	100 MHz
Level	+6 dBm

(4) A1074 MODULATOR BOARD 2

Controls the level of 300MHz modulated signal in 0.1 dB steps.
Converts the 300MHz modulated signal to 1.2GHz signal using 1.5GHz local signal.

·Input

1) Modulated signal

Frequency	300 MHz (CW/MOD)
Level	-5 dBm

2) Local signal

Frequency	1.5 GHz
Level	-13 dBm

·Output

Frequency	1.2 GHz(CW/MOD)	
Level	-2 dBm +1dB/-2dB	(Normal mode)
	-2 dBm +9dB/-14dB	(Level continuous mode)

(i) 300MHz AMP CONT

Controls 300 MHz modulated signal level, as follows.
·3dB width variable in 0.1 dB step (Normal mode)
·23dB width variable in 0.1 dB step (Level continuous mode)
Attenuates the level by 40 dB in burst off interval

·Input	Frequency	300 MHz	
	Level	-5 dBm	
·Output	Frequency	300 MHz	
	Level		
	-2 dBm	+1dB/-2dB	(Normal mode)
	-2 dBm	+9dB/-14dB	(Level continuous mode)

(5) A1075 1.5GHz GENERATOR

Receives 100MHz signal, and outputs 1.5GHz signal.

·Input	Frequency	100 MHz
	Level	≧ +7 dBm
·Output	Frequency	1.5 GHz
	Level	-11 dBm

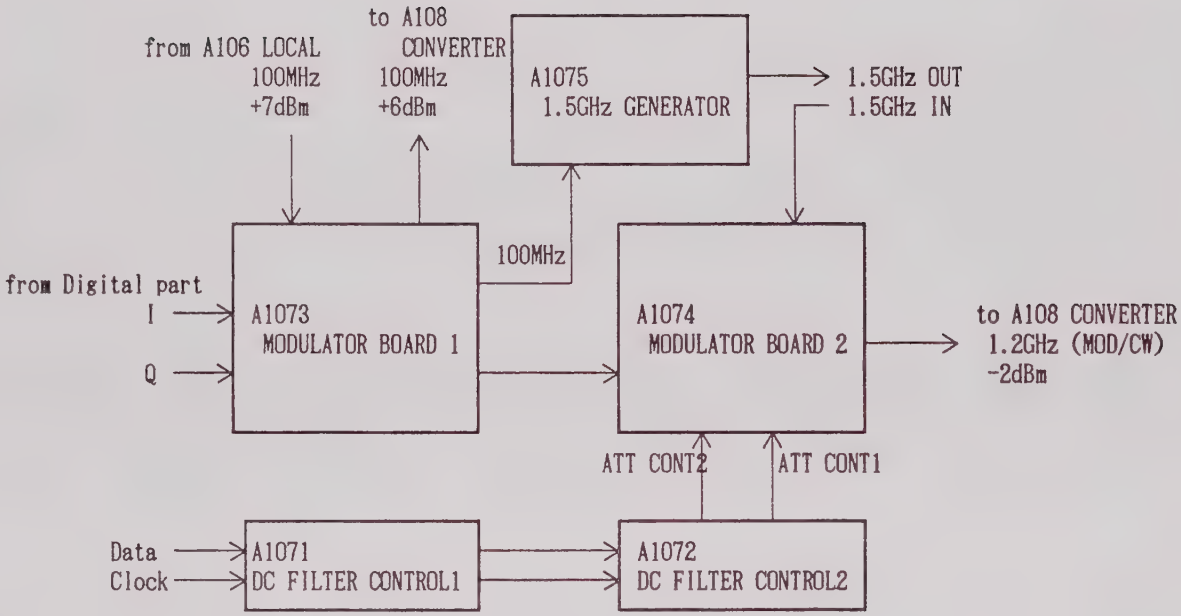


Fig. 2-7 A107 MODULATOR Block Diagram

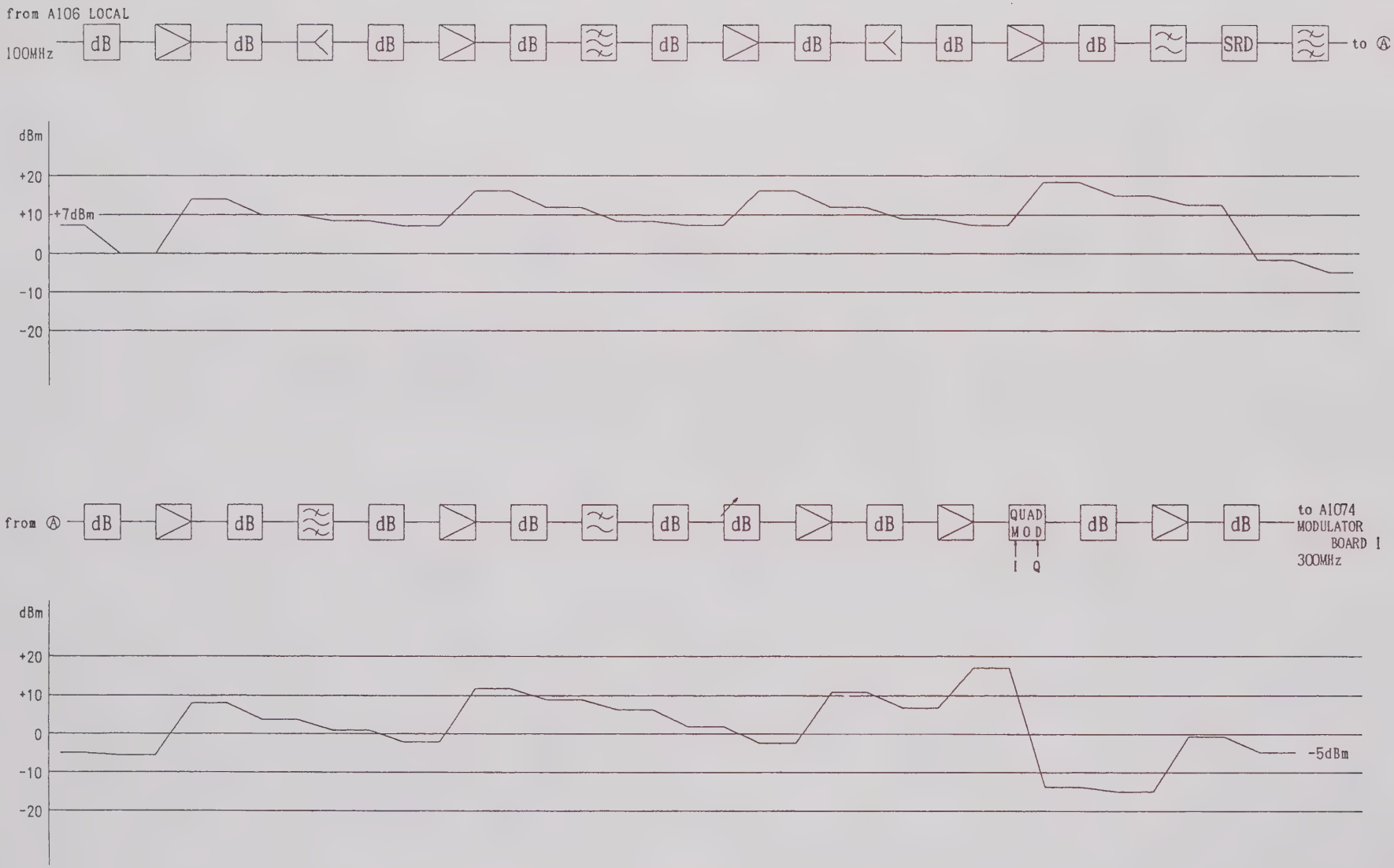


Fig. 2-8 A1073 MODULATOR BOARD 1 Level Diagram.

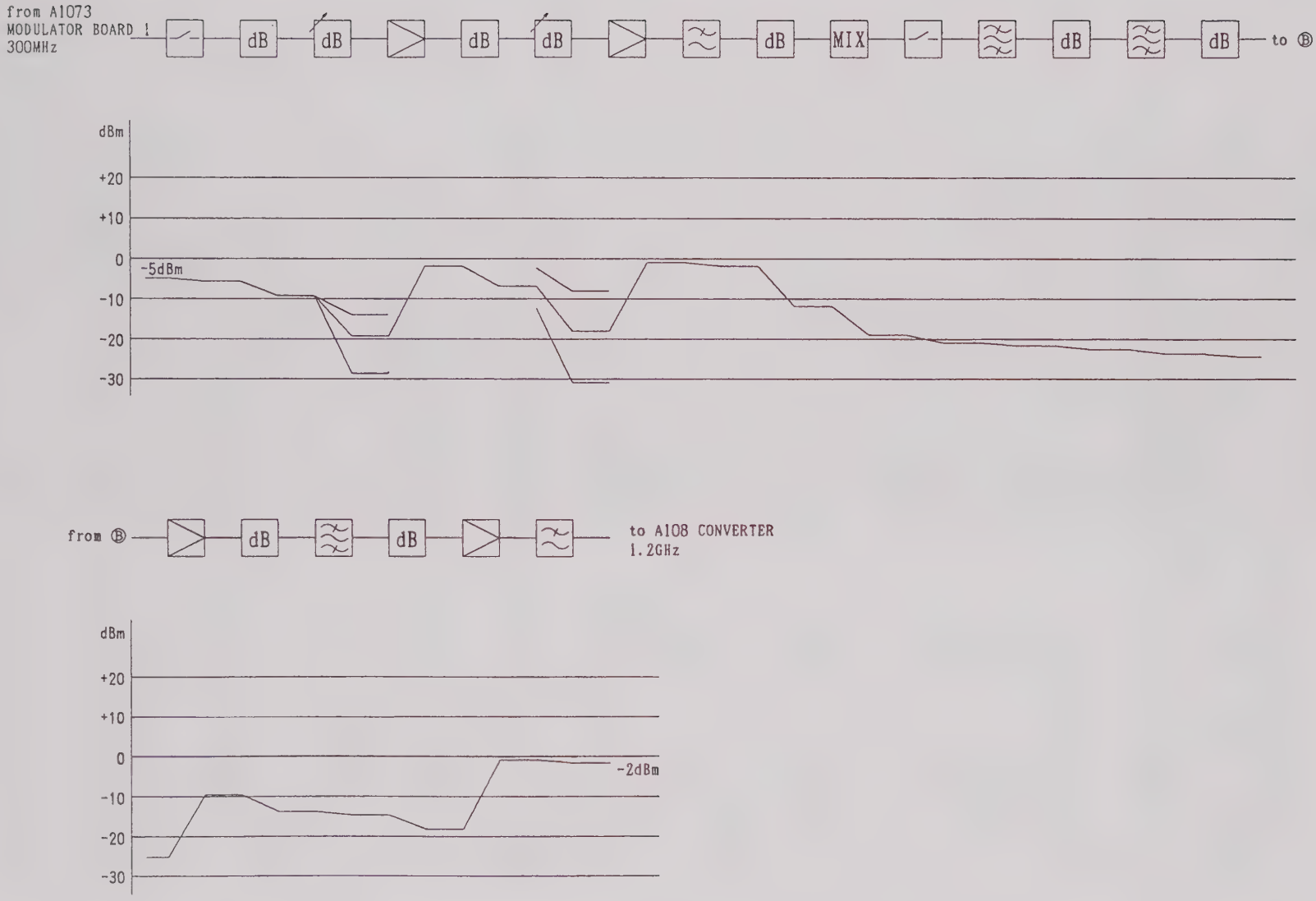


Fig.2-9 A1074 MODULATOR BOARD 2 Level Diagram.

2.2.7 A108 CONVERTER

Converts the 1.2GHz modulated signal to 0.3～2650MHz/1Hz-step modulated signal using 5.4～8.1GHz/1Hz-step local signal.

(1) A1081 CONVERTER FILTER

- ·Rejects noise from power supply lines.
- ·Supplies dc power to units.
- ·Transfers signals between units.

(2) A10821 4.2GHz PLL

Synchronizes 4.2GHz OSC to 100MHz reference signal, and outputs 4.2GHz local signal.

·Input

1) Reference signal

Frequency	100 MHz
Level	+6 dBm

2)VCO信号

Frequency	4.2 GHz
Level	0 dBm
C/N	-115 dBc/Hz at 10 kHz offset

·Output

Frequency	4.2 GHz
Level	+19 dBm
C/N	-115 dBc/Hz at 10 kHz offset

(3) A10822 4.2GHz OSC

·Output

Frequency	4.2 GHz ±500 kHz
Level	0 dBm
C/N	-115 dBc/Hz at 10 kHz offset

·Control voltage 0 ～ 10 V

·Oscillation frequency sensitivity 100 kHz/V

(4) A1083 2ND BEAT UP

Frequency-converts the 1.2GHz modulated signal to 5.4GHz modulated signal.

·Input

1) Modulated signal

Frequency	1.2 GHz(CW/MOD)	
Level	-2 dBm +1dB/-2dB	(Normal mode)
	-2 dBm +9dB/-14dB	(Level continuous mode)

2) Local signal

Frequency	4.2 GHz
Level	+19 dBm

·Output

Frequency	5.4 GHz(CW/MOD)	
Level	-9.5 dBm +1dB/-2dB	(Normal mode)
	-9.5 dBm +9dB/-14dB	(Level continuous mode)

(5) A1084 DOWN CONVERTER

Down-converts the 5.4GHz modulated signal to 0.3～2250(2100*)MHz/1Hz-step modulated signal using 5.4～7.65(7.5*)GHz/1Hz-step local signal, and outputs it.

·Input

1) Modulated signal

Frequency 5.4 GHz(CW/MOD)

Level -9.5 dBm +1dB/-2dB (Normal mode)
-9.5 dBm +9dB/-14dB (Level continuous mode)

2) Local signal
Frequency 5.4 to 7.65(7.5*) GHz
Level +4 dBm

·Output
Frequency 0.3 to 2250(2100*) MHz(CW/MOD)
Level -23 dBm +1dB/-2dB (Normal mode)
-23 dBm +9dB/-14dB (Level continuous mode)

*: For MG3670A

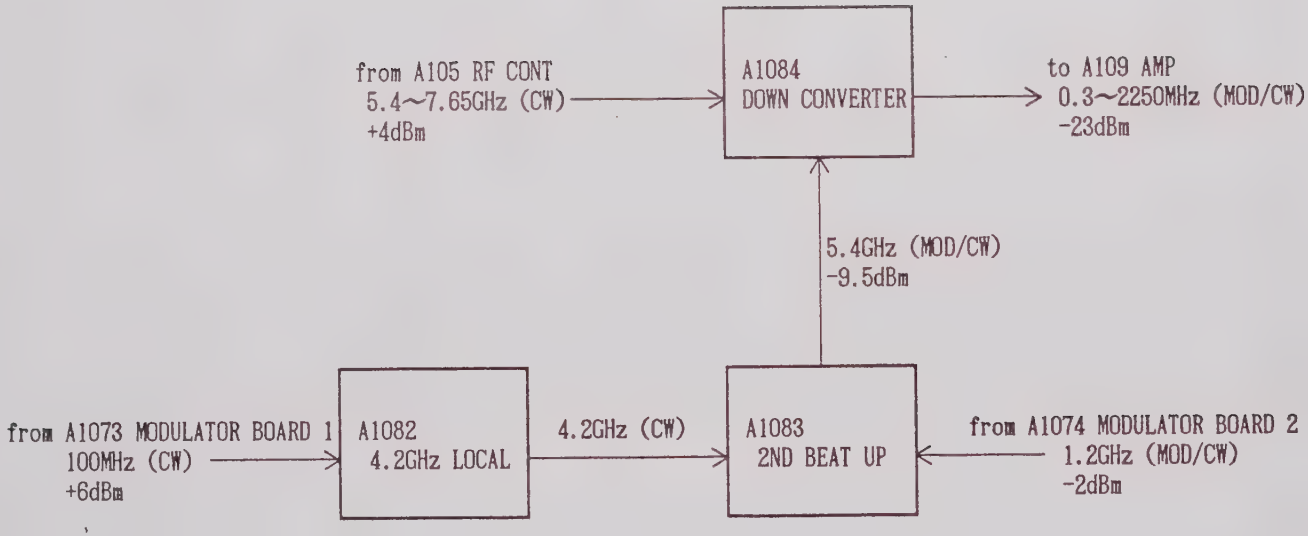


Fig. 2-10 A108 CONVERTER Block Diagram

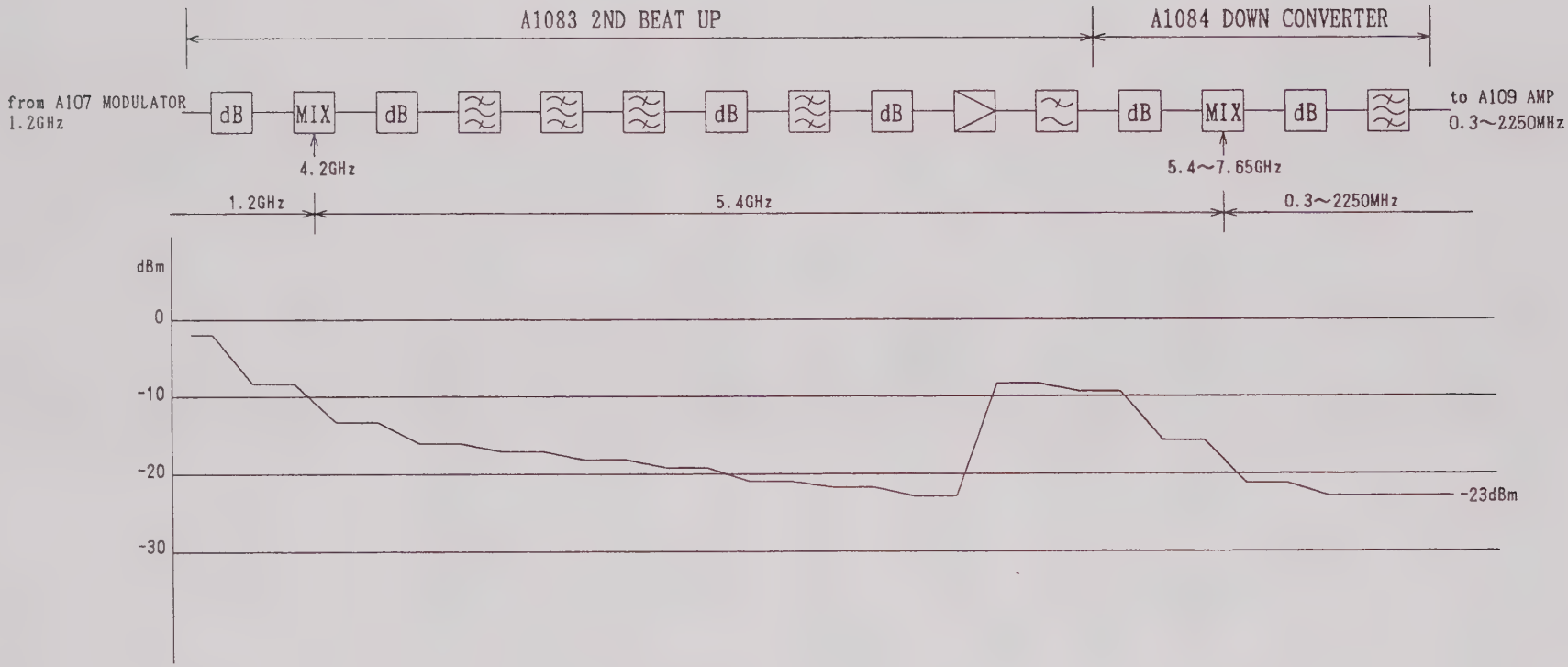


Fig.2-11 A108 CONVERTER Level Diagram

2.2.8 A109 AMP

·Receives 0.3 to 2250(2100*)MHz/-23dBm signal, amplifies/attenuates it to -143～+13dBm signal, and outputs it.
·Outputs level-detection signal to a CPU which corrects the output level in ±5dB.
·Contains RPP(Reverse Power Protection) circuit.

(1) A1091 RF AMP

·Receives 0.3～2250(2100*)MHz/-23dBm signal, amplifies it to -2.5～+18.5dBm signal, and outputs it.
·Outputs level-detection signal to a CPU which corrects the output level in ±5dB.

·Input

Frequency	0.3 to 2250(2100*) MHz (CW/MOD)	
Level	-23 dBm +1dB/-2dB	(Normal mode)
	-23 dBm +9dB/-14dB	(Level continuous mode)

·Output

Frequency	0.3 to 2250(2100*) MHz (CW/MOD)
Level	-2.5 to +18.5dBm

·Level-detection signal

0.5Vmax
RF signal (f<10MHz)
Detection signal(f≧10MHz)

(2) A1092 CONNECT BOARD 1

·Rejects noise from power-supply lines.
·Supplies dc power and outputs control signals to A1091.

(3) A1093 R.P.P

Detects the reverse power at RF Output connector, and cut off the RF output route if the detected power becomes over a predetermined value.

(4) A1094 RF DRIVER 1, A1095 RF DRIVER 2

Receives a control signal from A1096, and controls two P-ATTs (programmable attenuators) to obtain 140dB/1dB-step attenuation.

(5) A1096 CONNECT BOARD 2

·Rejects noise from power-supply lines.
·Supplies dc power and outputs control signals to A1093/A1094/A1095.
·Receives the control signal(STATUS) from A1093.

*:For MG3670A

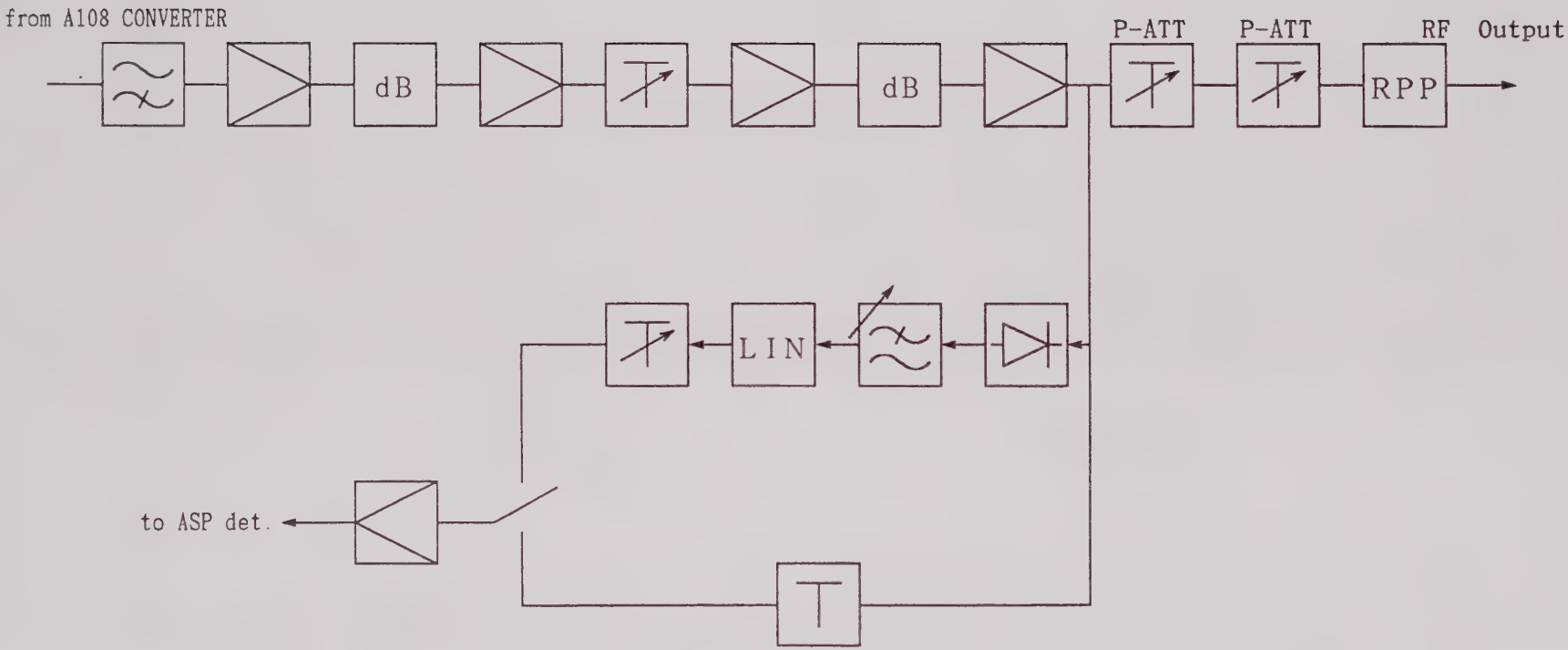


Fig. 2-12 A109 AMP Block Diagram

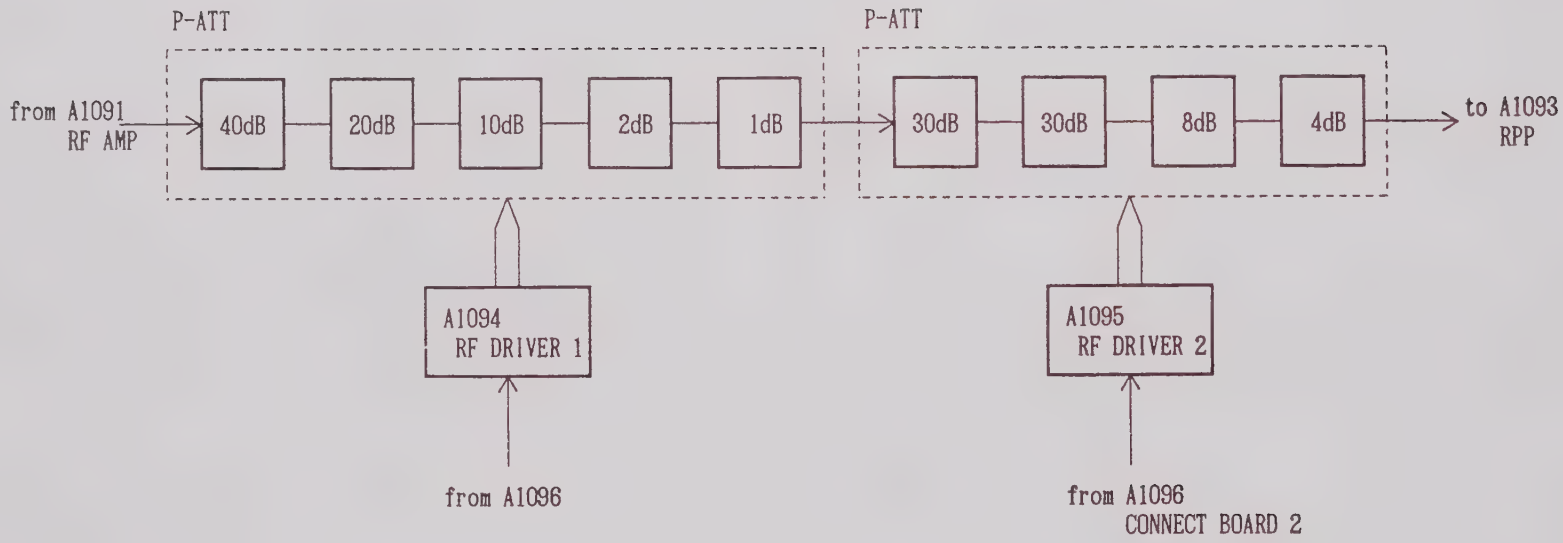


Fig. 2-13 P-ATT and RF DRIVER Block Diagram

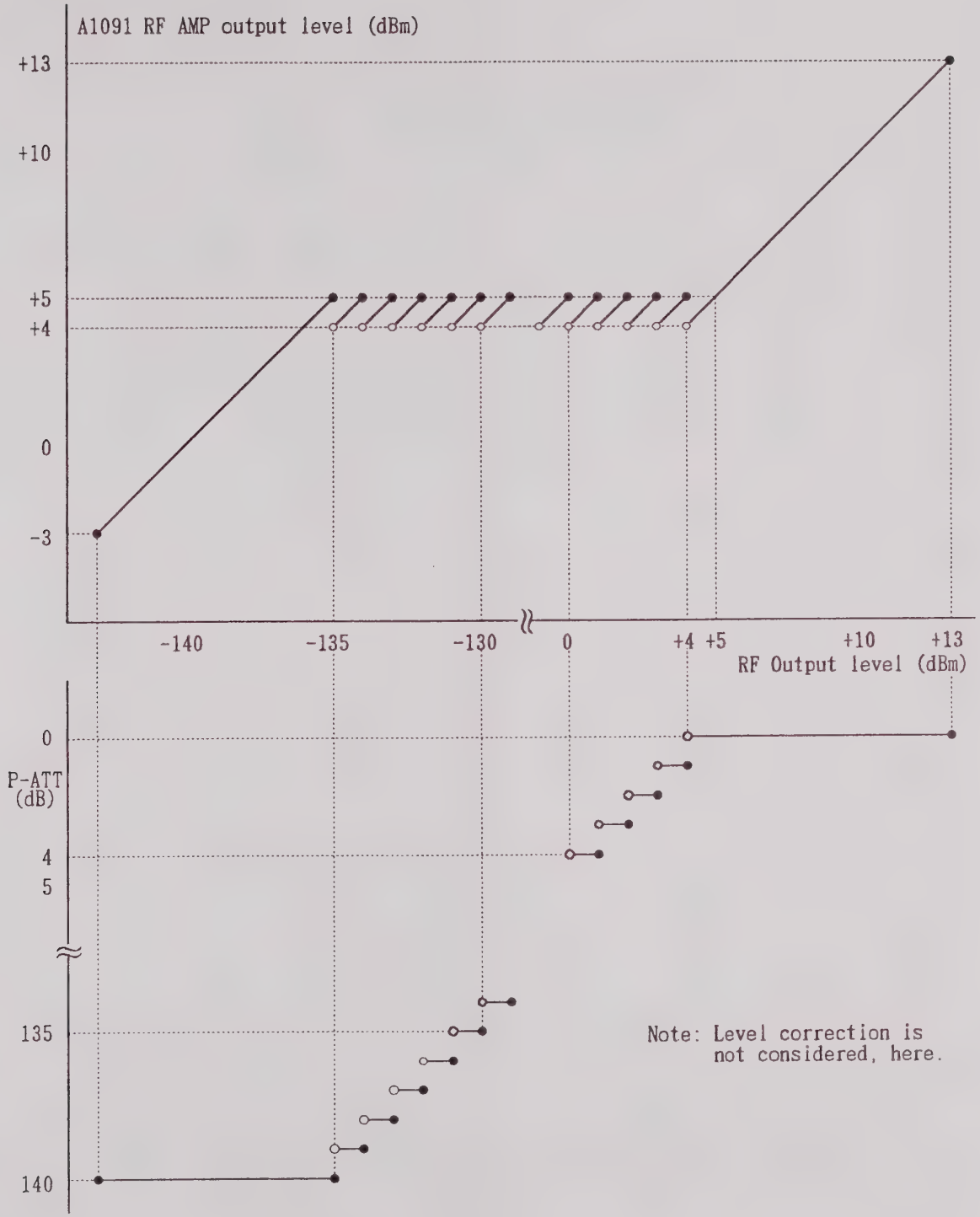


Fig. 2-14 Relation between RF Output Level, A1091 RF AMP Output Level, and P-ATT Attenuation

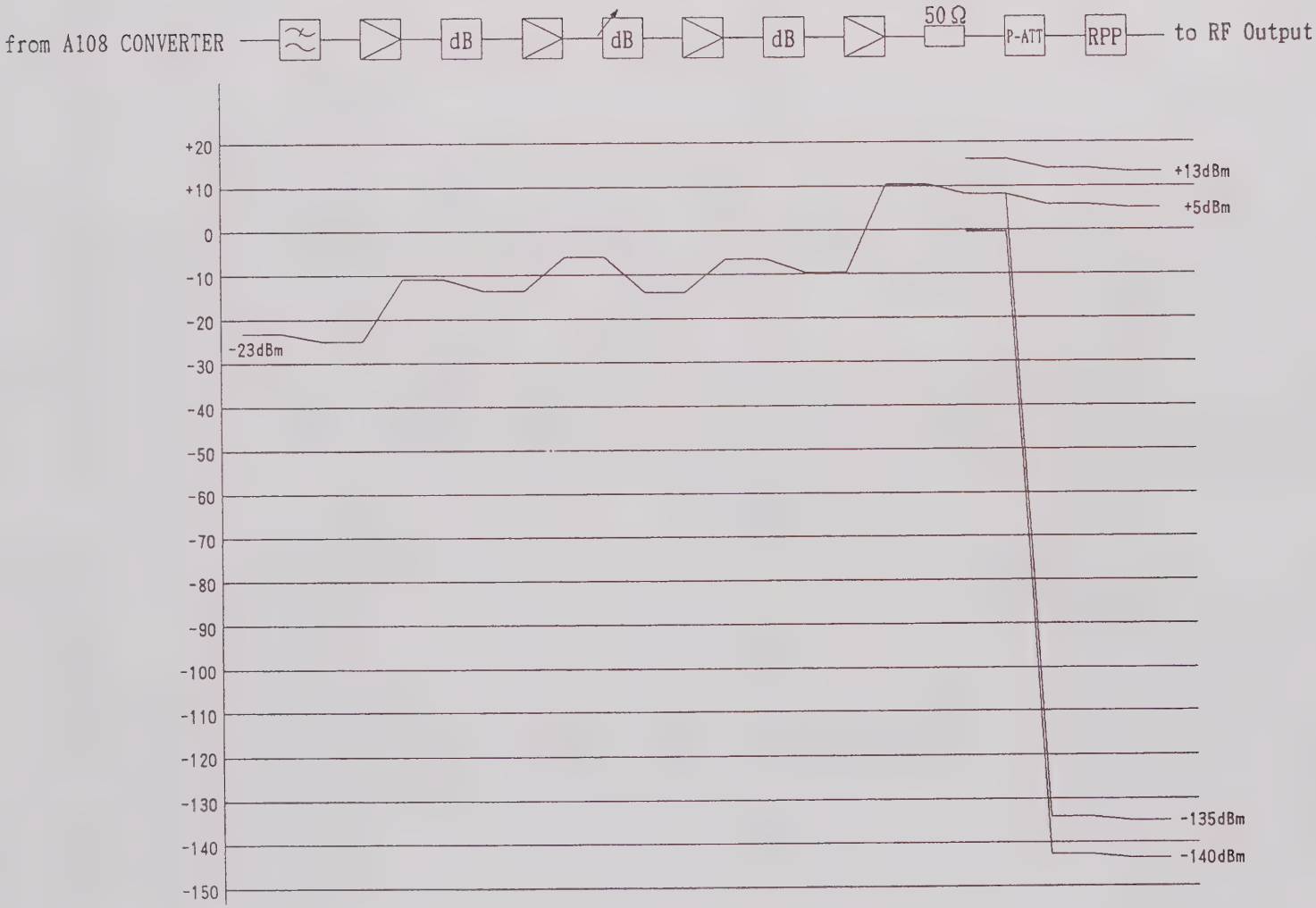


Fig. 2-15 A109 AMP Level Diagram.

2.2.9 A110 10/100MHz REF

Outputs 10 MHz and 100 MHz reference signals.

·Input	-12 V	(Power supply for 100 MHz VCXO)
	-6 to +10 V	(Control voltage for 100 MHz VCXO)
	+12 V	(Power supply for 10 MHz REF, 0.47 Amax)
·Output	100 MHz	(≧ +7dBm/50Ω)
	10 MHz	(TTL level)

2.2.10 A111 1/10,13 DIVIDER

Frequency-divides/multiplies reference signal(10MHz or 13MHz) to output 1MHz and 10MHz. Contains power-supply filters(A1111 DIVIDER FILTER).

·Input	10 or 13MHz (TTL level)	
·Output	10 MHz	(+10 dBm)
	1 MHz	(TTL level)

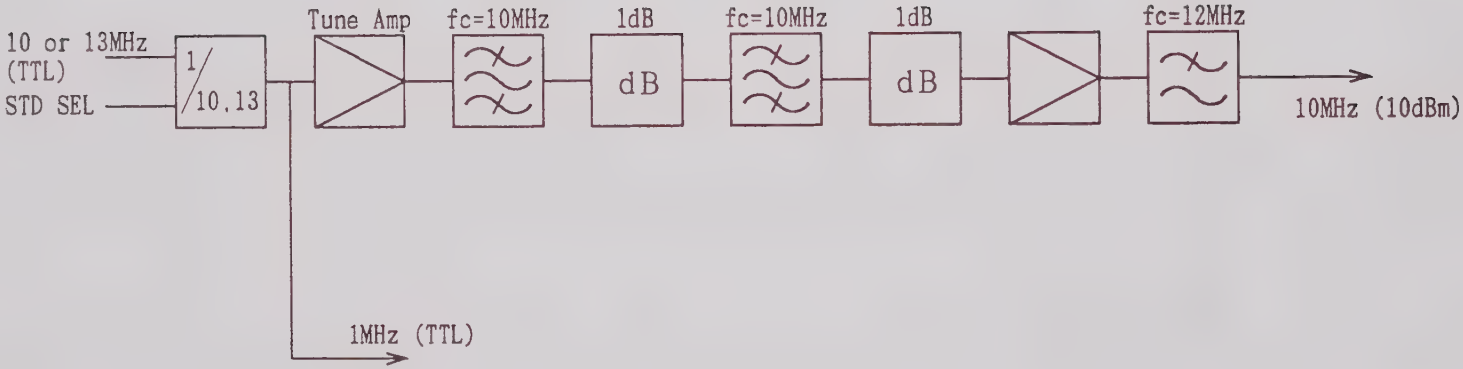
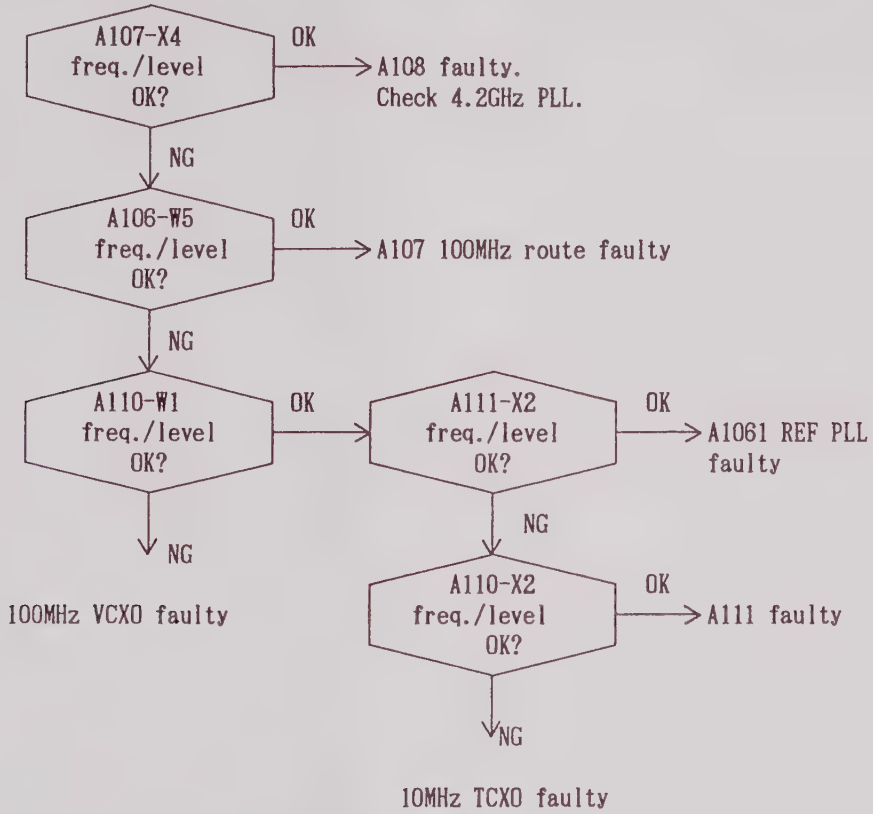
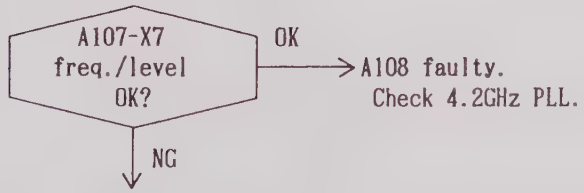


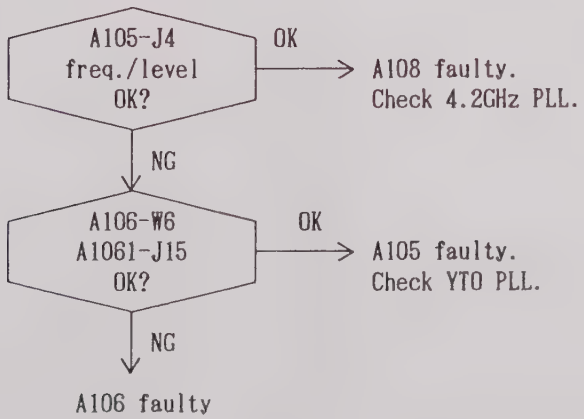
Fig. 2-16 1/10,13 DIVIDER

2.2.11 Troubleshooting RF section

When the RF Output or A108(CONVERTER) X5 output frequency is not phase-locked, find faulty unit as follows.







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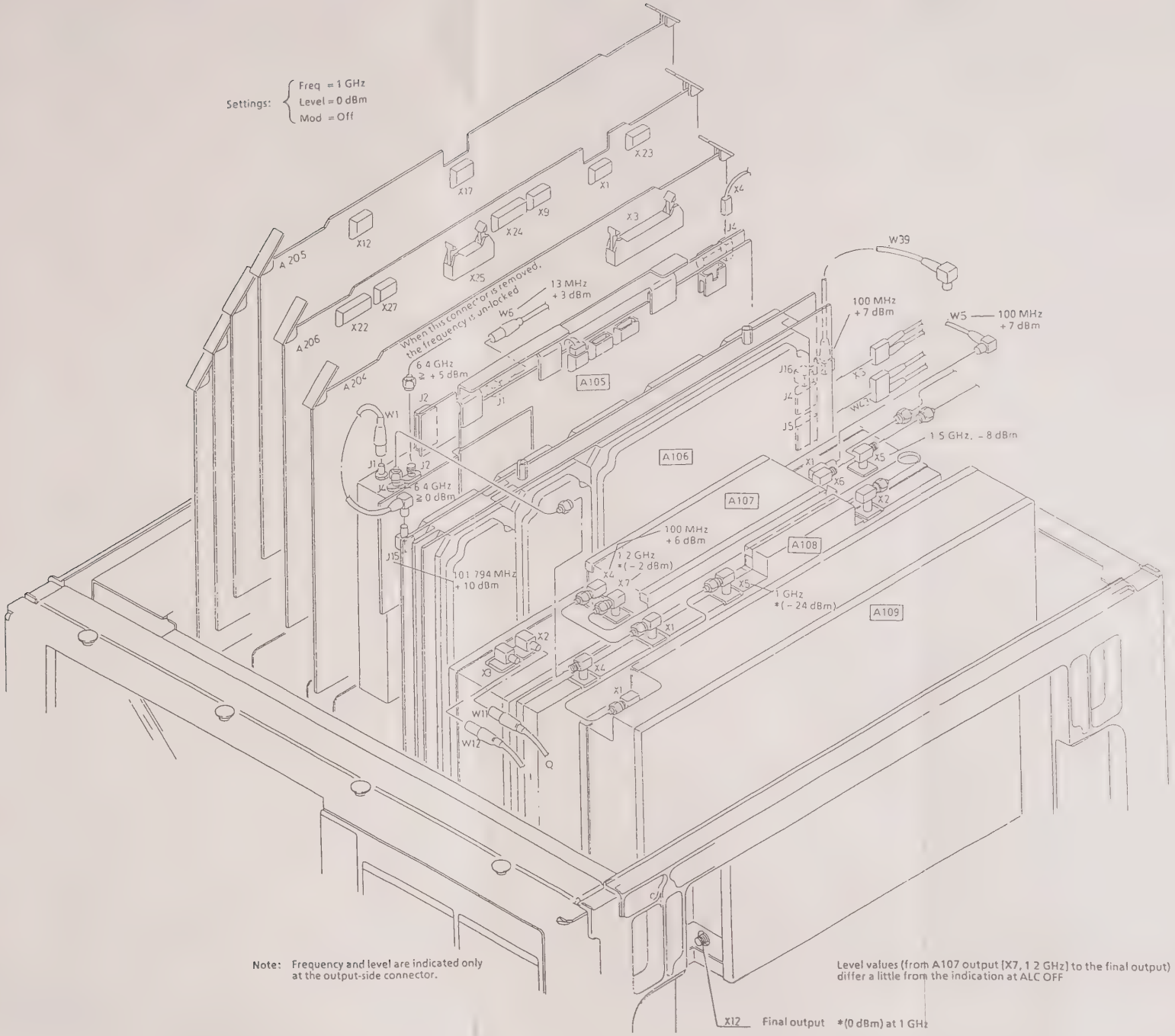

Fig. 2-17 Output Level at RF Section

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2.3 A204 CPU BOARD

A204 CPU BOARD uses 68000(12MHz) CPU, and has 1-Mbyte ROM area.
Peripheral devices are composed of GPIB, DANET, and ACRTC.
Fig. 2-18 shows the block diagram.

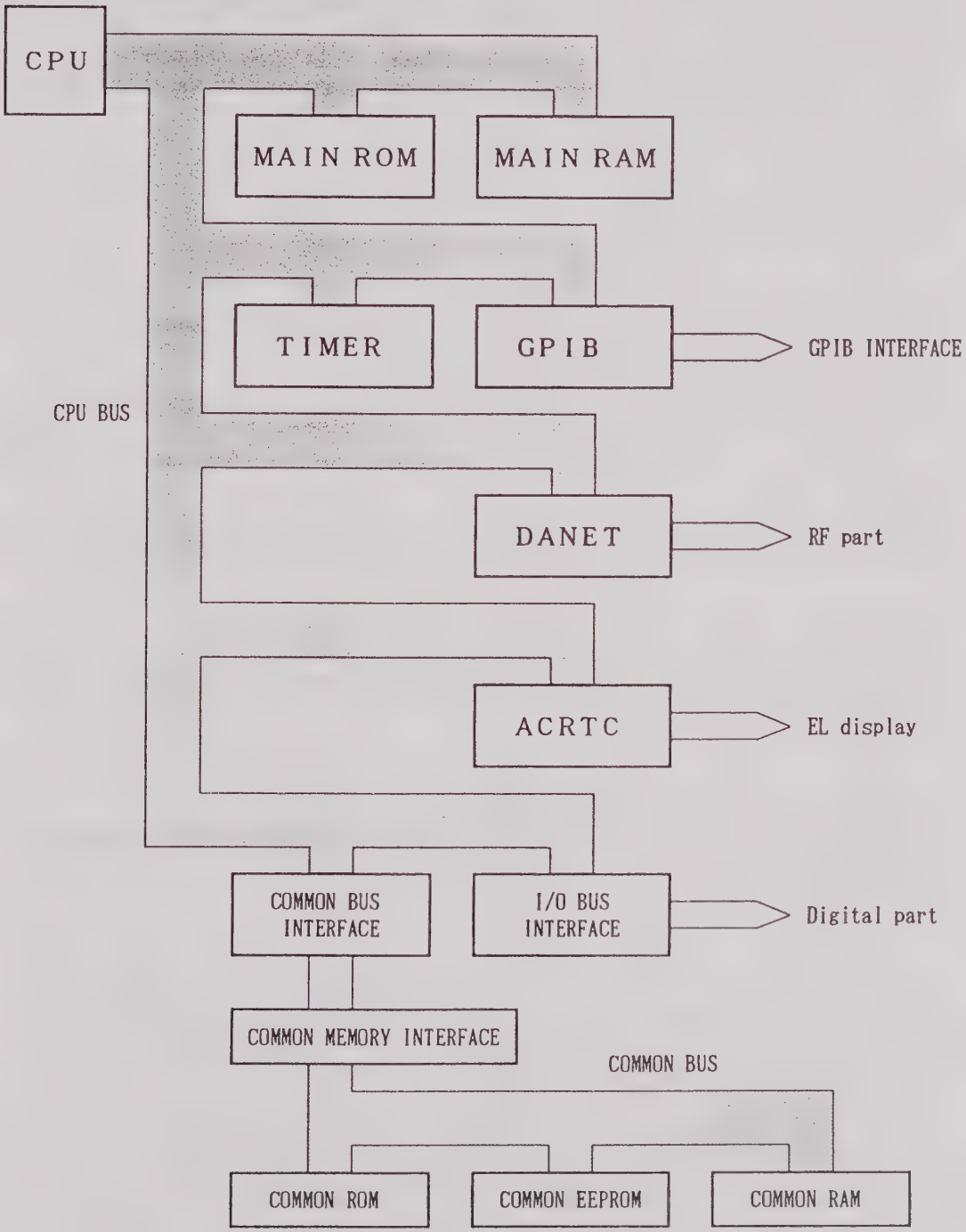


Fig. 2-18 A204 CPU BOARD Block Diagram

2.4 A205 ASP1

Converts I/Q data(output from A701/A702/A703) to analog signals, and outputs to A206 ASP2 and I/Q Output terminals on the front panel.

2.5 A206 ASP2

- Controls dc-offset/amplitude/phase(only for output signal) of the IQ output signals and IQ input signals.
- Corrects the quadrature ratio of the I/Q modulator, IQ balance, and carrier leak.
- Receives RF-detection signal, calculates level error, and outputs the error correction signal to CPU.

2.6 A3 MOTHER BOARD

- Supplies dc power to units.
- Transfers data between units.

2.7 A4 PANEL PART

- Panel keys and key encoder

  Generates key code(8 bits) corresponding to the pressed key, and outputs an interruption signal to A204 CPU BOARD.
- Rotary encoder(data knob) and control LSI(μPD4701)

  Rotary encoder generates a pair of pulses with 180° phase difference, according to the rotation.

  The control LSI detects the amount and direction of the rotation, and outputs the data (binary) to CPU.
- External input/output adjustment circuit

  Contains offset/balance adjustment circuits for outputting internal I/Q signals and receiving external I/Q signals.

2.8 A701 $\pi/4$ DQPSK

A701 is an optional unit for $\pi/4$ DQPSK modulation system.

A701 converts a externally-input modulation data(TTL) or internal pattern-generator data to I/Q signals.

Fig. 2-19 shows the block diagram.

2.9 A702 GMSK

A702 is an optional unit for GMSK modulation system.

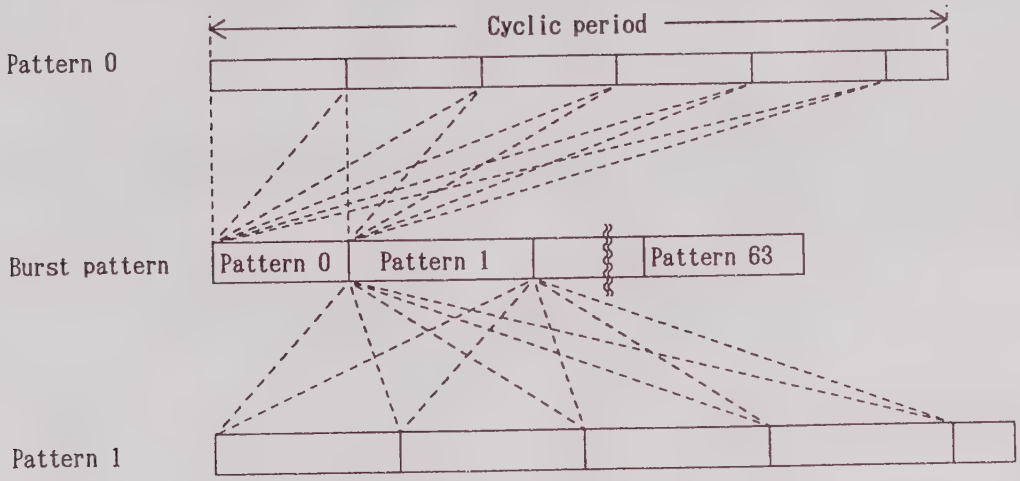
A702 converts a externally-input modulation data(TTL) or internal pattern-generator data to I/Q signals.

Fig. 2-20 shows the block diagram.

2.10.1 Generating burst pattern

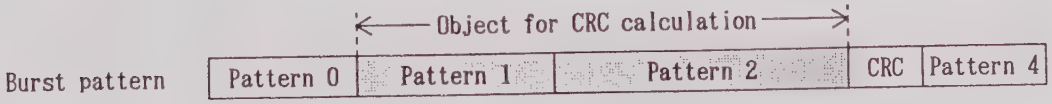
(1) Configuration of burst pattern

The burst pattern with multiple(max. 64) patterns of any arbitrary cyclic period (2 to 2^{20}) can be combined by any bit length(2 to 65535) using a software.



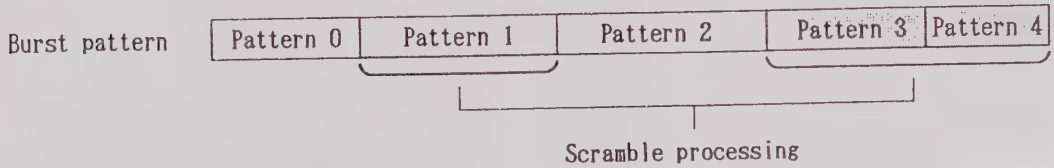
(2) Generating CRC

A9 performs CRC calculation for a specified pattern in a burst pattern, and inserts the results to the burst pattern.



(3) Adding scramble

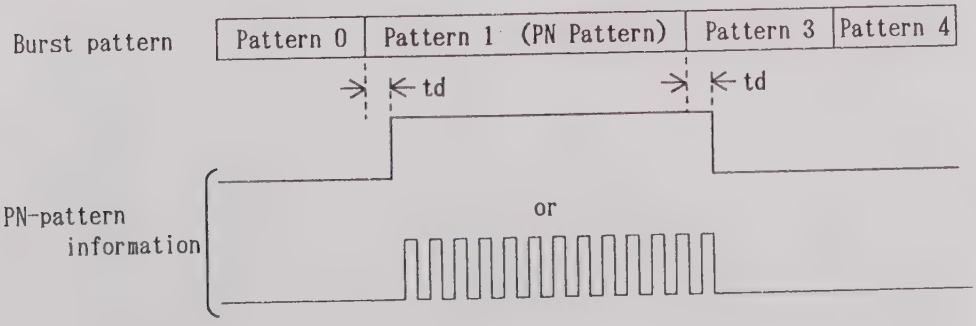
Performs scrambling for a specified pattern in a burst pattern



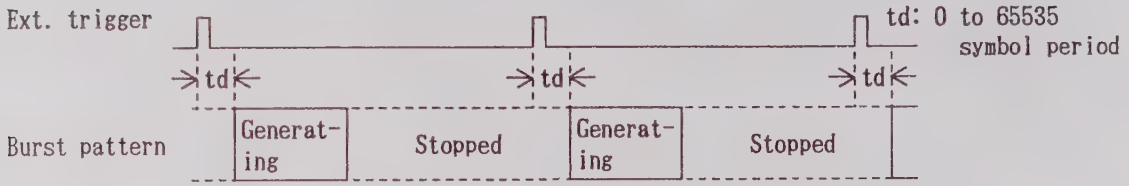
(4) Generating PN-pattern information

When the pattern in a burst pattern is PN pattern, a bursted clock or a gate signal can be output.

The output delay time "td" can be adjusted at 0 ～ 4095 bits in 1/16-bits steps.

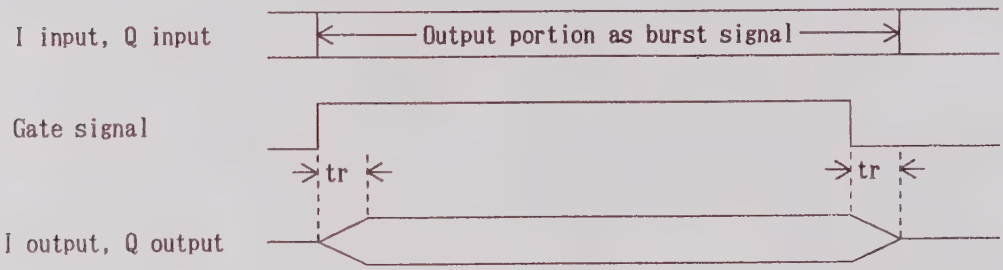


(5) Synchronizing burst pattern to external trigger
Generates a burst pattern synchronized to an external trigger signal.



2.10.2 Controlling I/Q amplitude

Adds the ramp-shaped rising/falling edges to the gate signal from the burst pattern generator or to the 12-bit quantized I/Q input signal according to an external gate signal, and outputs it.
The ramp bit length is 2 or 3 symbols.



tr, tf: 2 or 3 symbols

2.11 A703 GFSK

A703 is an optional unit for GFSK modulation system.
A703 converts a externally-input modulation data(TTL) or internal pattern-generator data to I/Q signals.
Fig. 2-21 shows the block diagram.

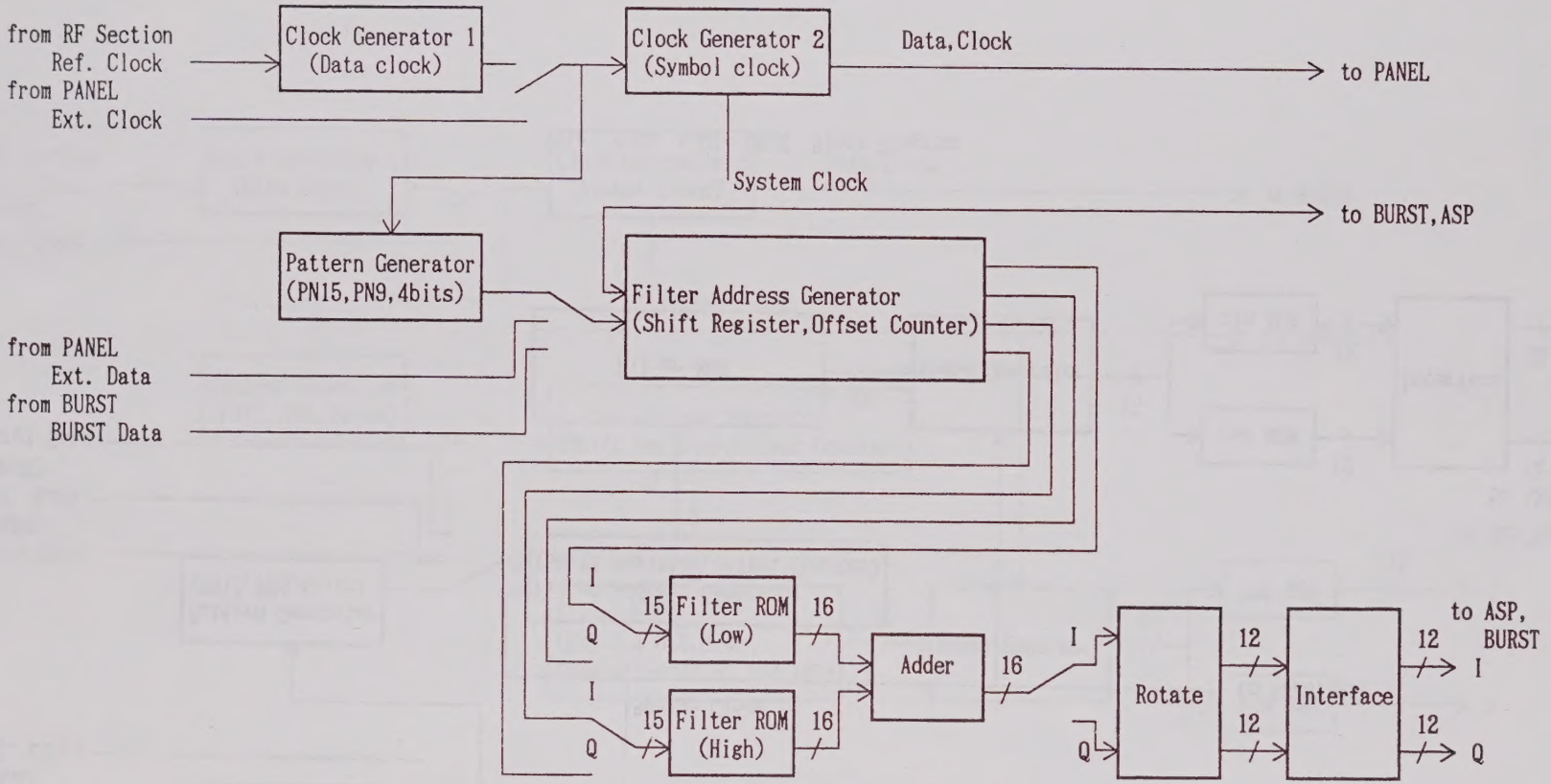


Fig. 2-19 A701 $\pi/4$ DQPSK Block Diagram

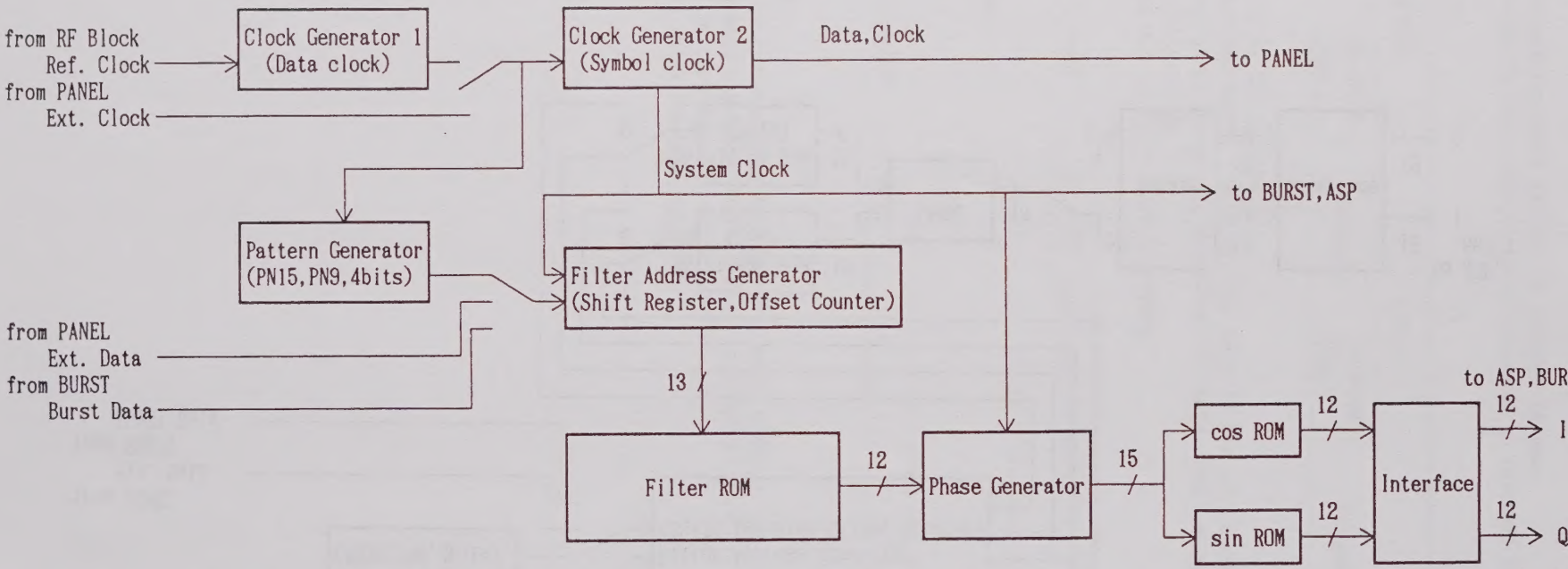


Fig. 2-20 A702 GMSK Block Diagram

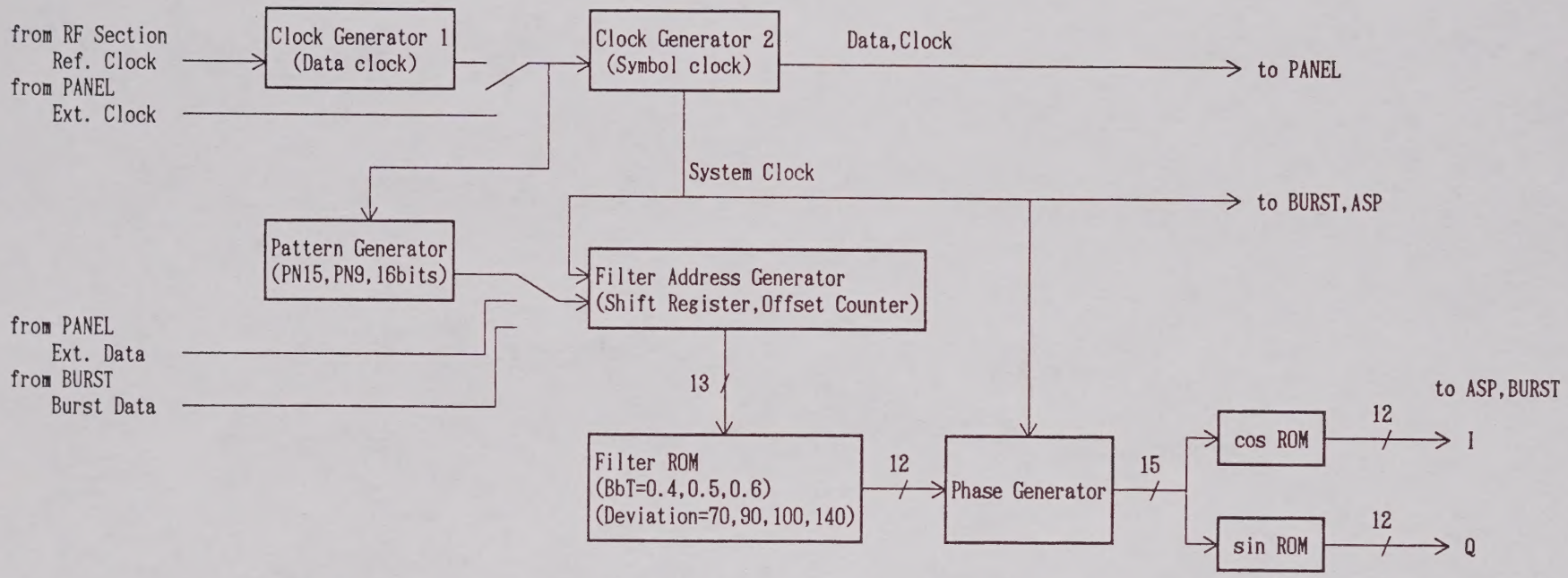


Fig. 2-21 A703 GFSK Block Diagram

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